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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	35684.0101 (P0002)
First Inventor or Application Identifier	Gard
Title	Computer Interface Device
Express Mail Label No.	EM519895724US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original, and a duplicate for fee processing)*
2. [X] Specification [Total Pages 19] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 13]
4. Oath or Declaration [Total Pages 2]
   a. [ ] Newly executed (original or copy)
   b. [X] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 17 completed)* ***[Note Box 5 below]***
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. [X] Incorporation By Reference *(useable if Box 4b is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [ ] Assignment Papers (cover sheet & document(s))
9. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document *(if applicable)*
11. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
12. [ ] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
14. [X] * Small Entity Statement(s) *(PTO/SB/09-12)* [X] Statement filed in prior application, Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [X] Other: Revocation/Appointment of Power of Attorney

*A new statement is required to be entitled to pay small entity fees, except where one has been filed in a prior application and is being relied upon.

17. If a **CONTINUING APPLICATION**, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
    [X] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. 08 / 778,978
    Prior application information: Examiner Luu, M. *Group / Art Unit:* 2775

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Signature	Shireen Irani Bacon	Date	1/6/99

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Docket No.: 35684.P002

PATENT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Inventor(s): Matthew Davis Gard
Serial No.:
Filed: New Application
For: Computer Interface Device
Docket No.: 35684.P002

Inventor: Matthew Davis Gard

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Deposit No.: 194547

This application is a continuation application of U.S. Pat. App. Ser. No. 08/778,978, filed January 2, 1997, now U.S. Pat. No. _____, which is incorporated by reference for all purposes into this application.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a computer interface device for controlling the position of a cursor on a computer monitor. More generally, the device can be used to detect a user's position and translate this position into a distinguishable input for a computer.

Description of the Related Art

Most computers today use a "mouse" to control the location of a cursor on the screen. It is important to be able to quickly and accurately position the cursor, especially when working with programs having a graphical user interface. The mouse is a simple device which uses a roller ball. As the mouse is moved, the roller ball moves two perpendicular sensors. One sensor detects movement towards or away from the user. The other sensor detects movements to the left or right of the user. These movements can be referred to as measured on an x-y plane. Thus, even angular movements will produce both an x-component and a y-component. These values are then translated into movement of a cursor displayed on the monitor.

The mouse, while revolutionary in its day, has numerous mechanical parts which can break or malfunction. A common problem is the accumulation of lint, carried by the roller ball and lodged against the sensor. This prevents the sensor from properly recording the movement of the roller ball. Further, the ball can become irregular with time, making it more difficult to roll.

Another problem occurs when the mouse is placed upon a smooth surface. Even if the surface of the roller ball is textured, it can slide rather than roll. Again the result is unpredictable movement of the cursor on the screen.

A final problem exists regarding a handicapped user's ease of use. If the user has no hands or has been crippled, a tactile device such as a mouse is difficult to manipulate. A need exists for a method and apparatus to control a cursor's position without the use of a tactile mechanical device. Such a device in a more generic sense could be used in any hand's free interaction with a computer. For example, a severely handicapped user should be able to manipulate the device with the movement of a straw-like extension held in his mouth.

Such a computer interface need not be solely restricted to the manipulation of a personal computer. Many industries have used automated machinery to improve the efficiency of their production. The machinery is controlled by a program. Safety hazards are presented when workers work in proximity to automated machinery. It would be beneficial to have a means to detect the location of a worker and alter the movement of the automated machinery to avoid that location.

Finally, a need exists for an input device which seamlessly integrates with modern three-dimensional graphic displays. For example, "virtual reality" goggles and autostereoscopic projection devices produce three-dimensional images. A new input device is needed which allows a user to interact with the image without invasive tactile attachments.

SUMMARY

The present invention relates to a three dimensional, gesture recognizing computer interface. Its mechanical design allows its user to issue complex data to a computer without the use of a keyboard, a mouse, track-ball, or similarly tactile forms of cursor/input/tool control. Its desktop and laptop configurations are designed to contribute further to simplifying the workplace. The device can be attached to a keyboard or a monitor or any other location in proximity to the user.

The control device uses analog circuitry to determine the amplitude of change in the dielectric area of an orthogonal array of conductors. Changes in tank-oscillators within the analog circuit are produced when a person disturbs the equilibrium of the dielectric regions of the geometrically arranged conductor array. The control device typically guides a travel-vector graphic indicator as feedback to user gestures. In another embodiment, the sensitivity of the unit is increased to recognize specific smaller user gestures. Also known as pick gestures, a user could merely tap a finger downward to simulate the pressing of a mouse button instead of a larger arm-pointing gesture in a less sensitive embodiment.

In a broader application, a panel sensor can be placed on the wall of a room. The location of a user within the room can be detected. Multiple panels can be linked together to establish greater sensitivity and accuracy. One application of this configuration is safety on the factory floor. The panels can detect the presence of a worker and alter the path of automated machinery in order to protect the worker.

BRIEF DESCRIPTION OF THE DRAWINGS

To further aid in understanding the invention, the attached drawings help illustrate specific features of the invention and the following is a brief description of the attached drawings:

Figure 1 illustrates the general motion of a user's hand being detected by the computer interface device of the present invention;

Figure 2 is a graphical representation of the output from the detector circuit when a "bounce" is detected;

Figure 3 is a schematic of the detector circuit;

Figure 4 is a flow chart illustrating the software interpretation of the circuit output;

Figure 5 , 5a, 5b and 5c illustrate a monitor mounted embodiment of the present invention;

Figure 6 illustrates a wall panel embodiment of the device;

Figures 7a to 7h illustrate a plurality of wall panel elements used to scan for movement within a room;

Figure 8 illustrates the use of detectors on the dash of an automobile to eliminate the need for certain manual controls;

Figure 9 illustrates the use of detectors on an automatic teller machine;

Figure 10 illustrates a table with a plurality of motion detectors mounted thereon;

Figure 11 illustrates a motorized wheel chair having an array of conductors; and

Figure 12 illustrates a robotic arm having detectors mounted thereon.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a computer interface device and more generically to a control device which senses a user's movements to initiate control actions. Figure 1 provides a general illustration of a user 10 gesturing within a field established by a first, second, and third conductors 102, 104, and 106. The third conductor 106 is extending from the page in the z-axis. The conductors establish a capacitance with the air acting as a dielectric. The dielectric constant is disturbed by the presence of the user's hand or other extremity. Alternatively, the user's hand or other extremity forms the second plats of the capacitor along with the conductor. Movement of the user then alters the capacitance of this capacitor as the body provides a virtual ground to close the circuit. For example, the movement of the user's finger 12 in the upward direction as shown in the second frame creates a disturbance or "bounce effect." A detector circuit will sense this change, for example, as a voltage bounce 108 as shown in Figure 2.

Two of many types of gestures are illustrated by the two models:

Quadratic Fit: y=a+bx+ex^2

Sinusoidal Fit: y=a+b*cos(cx+d)

--where "**y**" is the magnitude of the device output and "**x**" is an iteration, or unit of time.

--"**a**" and "**b**" are the derived coefficients of the model based on the data.

If for example the user reaches toward a single conductor, and then withdraws, the gesture may modeled using the Quadratic form. If the user repeats the gesture continuously, the output would be modeled using the Sinusoidal form.

The two forms may be superimposed to scale upon the other. For example, were the user to reach out towards a single conductor and at some fixed point began fluttering his fingers, and then retract his hand, he would then need two samples: sample one, the entire gesture, and sample two, the disturbance to the Quadratic form of sample one. The fluttering fingers would be sinusoidal if the sample were to be reduced to just the oscillating fingers and not the broader arm gesture. Although it might be possible to model the system as a higher order differential equation, a programmer would choose to adjust the sampling to acquire key gestures and stimuli. For example, in the demonstration of reaching in, fluttering fingers, and then withdrawing, original Quadratic is disturbed. The wise programmer who fits the data to the quadratic will notice that the residuals of the function are oscillating and apply the second fit to the residuals over the disturbed sample area, thereby isolating and analyzing the embedded gesture in one step.

One of the most important issues that engineers must deal with today is the ergonomic qualities of their devices. Consumers are highly informed about the health problems caused by poorly designed, non-ergonomic products. From cars to computer keyboards, designers are obligated to take into consideration the user's comfort when designing a product. The utility of the control device 100 is that it is by nature ergonomic. The user does not impact any surface while using the device. The detector can also be refined to produce the desired output in response to comfortable performed motions by the user. Thus, if the control device is replacing a computer mouse, it need only be calibrated on several occasions before the user obtains an almost effortless ease in manipulating the cursor on the computer screen.

Figure 3 is a schematic of a detector circuit suitable for the present invention. The three conductors 102, 104, 106 are attached to x-axis, y-axis, and z-axis proximity detector circuits 110, 112, 114, respectively. As each circuit is similar, only the x-axis circuit 110 will be discussed. The detector circuit 110 is a cascade amplifier utilizing BJT transistors. The circuit is supplied by a regulated voltage supply 116. The circuit shows the use of three BJTs 120, 122, and 124. In a preferred embodiment, BJTs 120, 122 are model MPS3704, while BJT 124 is a model 2N3904. The biasing voltages can be adjusted through the use of various resistors and capacitors. Preferred values are shown. The input from the conductors are conditioned and amplified by the three proximity circuits 110, 112, 114. The output from the circuits are provided through the axis data information lines 118 to the computer.

Within the computer, the analog output signal is converted into a digital signal which can be manipulated. The analog to digital (A/D) resolution is important to the Control device in several ways. The further the stimulus is away from the receiver (Δh is large) the smaller the change in voltage (ΔV) sent from the analog circuit to the A/D. Therefore the A/D must be sensitive enough to detect the minute changes in the fringe region of the orthogonal array. The ideal control device has operating conditions residing solely in its optimal region where little or no resolutional nonlinearity occurs. Since a completely linear-unified 3D region-model for the array is desirable, the greater the resolution of the A/D, the greater the robust range of input.

Alternatively, a circuit that directly measures the oscillator frequency would provide a more sensitive (and probably easier to linearize) means of measuring position. In this case, the oscillator output would be fed directly into a frequency to digital converter (F/D). This can be

implemented in the computer. The F/D converter would simply involve gating the oscillator into a counter for a fixed interval, T. The contents of the counter N would be related to the oscillatory frequency, f by f=N/T. This process would be repeated with sufficient frequency, perhaps one hundred times per second, so that the output would, for the purposes of display or control, be continuous.

Since the actual change in capacitance caused by insertion of hands (or other objects) into a region of sensitivity is very small, perhaps of the order of 10^8 farads, the nominal or "undisturbed" frequency of the oscillator must be made relatively high. This is done to achieve a suitably large frequency swing when the region is "disturbed" by the presence of hands. The total frequency swing thereby becomes suitably large in an absolute sense, but is still very small as a percentage of the "undisturbed" or nominal oscillator frequency.

The overall sensitivity of the system can be enhanced by heterodyning the output of each variable oscillator with a common fixed oscillator, then using the resulting difference frequency for measurement purposes. To illustrate this, consider an undisturbed frequency of 1.1 megahertz ($1.1x1O^6$ cycles per second) and a maximum frequency swing, created by disturbing the field, of 10 kiloHertz (10,000 cycles per second). This amounts to a total frequency swing of less than one percent. If, however, the oscillator output is heterodyned with a fixed one megahertz signal, the resultant undisturbed frequency is 0.1 megahertz (or 100 kiloHertz) and the frequency swing of 10 kiloHertz (which is unchanged) is equivalent to ten percent, a ten-to-one improvement in sensitivity.

Figure 4 is a flow chart 200 which diagrams the interaction between the data collected from the conductors and the software program that translates that data into cursor positioning or other control actions. The input data 202 is initially collected and stored in a buffer. An initial calibration is then performed, establishing output limits based upon the input. The new data is then compared to the values used during the calibration. The differences are then used to create vector data 204 used to create new cursor position output. This raw vector data is then sized to best fit the monitor 206. Next, the vector quantities are applied 208 in an absolute sense to previous coordinate data. For example, the x-axis and y-axis values can be position or movement data. Z-axis values can be interpreted as scale values. Next, the cursor is plotted 210 in its new position using the vectors added to its old coordinates, additive method, or to a default position, absolute method.

Figure 5a is a preferred method of implementing the interface device to a personal computer. The apparatus 300 produces overlapping input and output regions 302, 304, using a first and second array of conductors 306, 308. Each array of conductors can contain any number of conductors, although four conductors is preferred. The first set of arrays 306 can be placed on the front of the monitor, while the second set can be placed on the keyboard. The user can then pass his hand or any other device in the overlapping field where it will be detected.

Figure 5b and 5c illustrate the use of the invention with an autostereoscopic display. Such displays can produce a three dimensional illusion or perceived image in front of the display. Such displays are produced by Neos Technology of Melbourne, Florida. In the example, a tennis ball 312 is displayed within the region banded by output regions 302, 304. Thus a user 314 can extend

his hand into this bounded region and interact with the three-dimensional display. The location of his hand is detected and the illusive ball 312 can respond to the illusion of touch.

Figures 6, 7a, and 7b illustrate the use of a multi-conductor panel 400. The panel 400 has any outer surface 402. On the outer surface, at least two conductors are 404, 406. The conductors are connected to a central input/output controller 310. Thus any capacitance disturbance detected by the conductors 404, 406 can be relayed to a detector circuit such as described above. Further, the panels can be connected to each other with a data bus 408. Thus, an entire room can be paneled with detector panels 400. The panels 400 room can be interrogated with various patterns to detect the location and limits of movement of a device within the room. For example, in Figure 7a, only the conductors on the panels which represent the very axes of the room are activated. Sequentially, the pattern can be changed to include the conductors illustrated in Figures 7b, 7c, 7d, and 7e.

Once connected, the panels can also be segmented to create specialized quadrants. For example, as shown in Figure 7f, if the room contained an automated machine 418, the panels closest to the machine's operating motion 420, 422 might be used to create the most accurate detection of motion. Further, as shown in Figure 7h, if more than one object is moving in the room, e.g. a worker near the machine, then two detection groupings 430, 432 could be analyzed.

Figure 8 illustrates the use of the detectors in an automobile interior. A dashboard could have virtual controls that were activated by the movement of a driver's hand. An exemplary dashboard 500 could contain a plurality of conductor arrays 502, each with at least two conductors 504, 506. If the array 502 represented the radio control, a user could adjust volume by pulling

his hand away from the array, and change channels by using a recognized hand gesture such as the formation of a J-shape with outstretched fingers. Of course the choice of commands and functions can vary.

Figure 9 illustrates the use of a conductor array 902 at an automated teller machine 600. This might be particularly useful for the blind. A blind user could approach the automated teller machine. When detected, the user could move his hand toward a desired key and be guided by a volumed plurality of tones. As he neared the key, for example, the volume could increase or the plurality of tones may be in unison when they were otherwise dissonant.

Figure 10 illustrates a work table 700 containing at least one set of conductor arrays 702. Machinery could be mounted on the table and monitored. Likewise, as on a work floor, the interaction of human operators and machinery could be monitored. Thus, if it appears that the worker might be injured by the movement of the machinery, then the movement can be altered or the machine powered down.

Figure 11 illustrates a motorized wheel chair 800 for use by a handicapped person. The wheel chair has a seat 804 connected to several wheels which are powered by a motor 802. The chair 800 typically has a desk top surface 806. Prior art motorized chairs typically have a simple lever controller. The user presses the lever forward to move the wheel chair forward. The user moves the lever to the side to move the wheel chair to the left or right. The use of a movement detector can replace a lever arrangement so long as there is a limiting filter present to subdue the "bounce"-like signal produced if the moving chair were to hit a bump to prevent erroneous control input while the chair is in motion. For instance, a first array 810 can replace the lever controller.

The user would merely manipulate his hand or other object within the range of the conductors. The changing capacitive field will be interpreted as discussed above. A second conductor array 808 can be placed on the desk top as well. The desktop can be shielded to prevent the user's leg movement from affecting the field around the conductors.

Figure 12 illustrates an embodiment of the invention wherein the conductors are placed on the moving armature of a machine. In this example, the conductors 902 are placed on a robotic arm 900. In the past examples, the conductors have been placed on a stationary object. This example illustrates that the opposite arrangement can also work. In other words, the robotic arm can be in movement around a stationary work piece that will be detected.

Although preferred embodiments of the present invention have been described in the foregoing Detailed Description and illustrated in the accompanying drawings, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications, and substitutions of parts and elements without departing from the spirit of the invention. Accordingly, the present invention is intended to encompass such rearrangements, modifications, and substitutions of parts and elements as fall within the scope of the appended claims.

Other embodiments of the invention will be apparent to those skilled in the art after considering this specification or practicing the disclosed invention. The specification and examples above are exemplary only, with the true scope of the invention being indicated by the following claims.

CLAIMS

I claim the following invention:

1. A control device that translates a user's non-tactile movement into a control action comprising:

one or more conductor arrays connected to one or more surfaces, wherein said conductor array comprises two or more conductors;

wherein at least one of said conductor arrays comprises a first conductor that senses the user's non-tactile movement within a first plane along a first axis of said surface;

wherein at least one of said conductor arrays comprises a second conductor that senses the user's non-tactile movement within a second plane along a second axis, perpendicular to said first axis;

a converter that translates the sensed movement into three-dimensional vector data; and

a controller that correlates said three-dimensional vector data into control movement.

2. The apparatus of Claim 1 wherein said converter comprises circuitry to determine the change in voltage in the dielectric area of said first and second conductors.

3. The apparatus of Claim 1 wherein said converter comprises circuitry to measure the change in the frequency of said first and second conductors.

4. The apparatus of Claim 3 wherein said converter further comprises circutry to heterodyne said frequency with a fixed oscillator.

5. A method of making an apparatus that translates a user's non-tactile movement into a control action comprising:

providing one or more surfaces;

providing one or more conductor arrays, wherein said conductor array comprises two or more conductors;

connecting one or more said conductor arrays to one or more said surfaces;

wherein at least one of said conductor arrays comprises a first conductor that senses the user's non-tactile movement within a first plane along a first axis of said surface;

wherein at least one of said conductor arrays comprises a second conductor that senses the user's non-tactile movement within a second plane along a second axis, perpendicular to said first axis;

providing a converter that translates said sensed movement into three-dimensional vector data;

coupling said converter to said conductors;

providing a controller that correlates said three-dimensional vector data into control movement; and

coupling said controller to said converter.

6. The method of Claim 5 wherein said step of providing a converter further comprises providing circuitry to determine the change in voltage in the dielectric area of said conductors.

7. The method of Claim 5 wherein said step of providing a converter further comprises providing circuitry to measure the change in the frequency of said conductors.

8. The method of Claim 7 wherein said step of providing a converter further comprises providing circuitry that heterodynes said frequency with a fixed oscillator.

9. A method that translates a user's non-tactile movement into a control action comprising:

sensing with a first conductor the user's non-tactile movement within a first plane along a first axis of a surface;

sensing with a second conductor the user's non-tactile movement within a second plane along a second axis, perpendicular to said first axis;

translating said sensed movement into three-dimensional vector data; and

correlating said three-dimensional vector data into control movement.

10. The method of Claim 9 wherein said step of translating further comprises determining the change in voltage in the dielectric area of said conductors.

11. The method of Claim 9 wherein said step of translating further comprises measuring the change in the frequency of said conductors.

12. The method of Claim 11 wherein said step of translating further comprises heterodyning said frequency with a fixed oscillator.

13. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps that translate a user's non-tactile movement into a control action, said method steps comprising the following steps:

sensing with a first conductor the user's non-tactile movement within a first plane along a first axis of a surface;

sensing with a second conductor the user's non-tactile movement within a second plane along a second axis, perpendicular to said first axis;

translating said sensed movement into three-dimensional vector data; and

correlating said three-dimensional vector data into control movement.

14. The program storage device of Claim 13 wherein said step of translating further comprises determining the change in voltage in the dielectric area of said conductors.

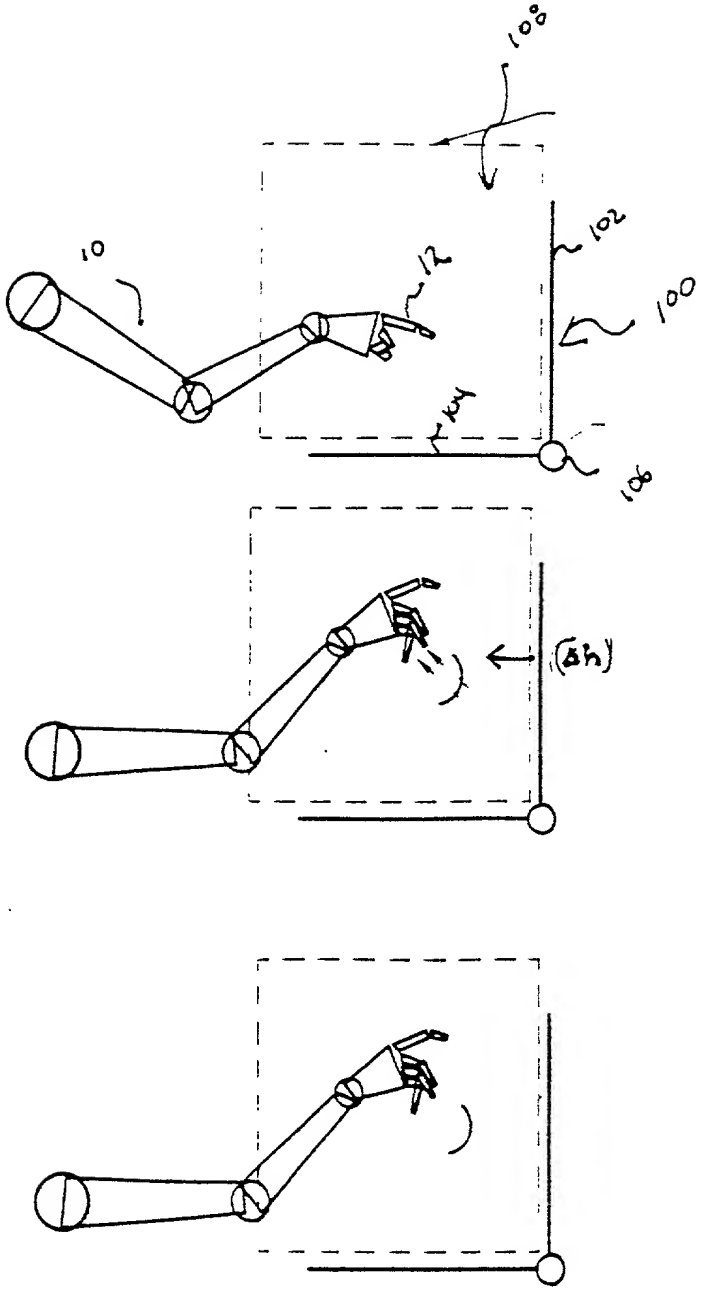
15. The program storage device of Claim 13 wherein said step of translating further comprises measuring the change in the frequency of said conductors.

16. The program storage device of Claim 15 wherein said step of translating further comprises heterodyning said frequency with a fixed oscillator.

ABSTRACT

A user's movements are detected by a capacitive system having one or more conductors. The output from the conductors is amplified and compared to a table of stored output. Thus, the device can eliminate the need to touch a control surface. The control surface such as a computer mouse could be eliminated in favor of merely sensing a user's hand movement. Likewise, the array of conductors could be placed in a panel that could be mounted on a wall. Such panels could be used in a factory to sense the movement of workers or a machinery. Indeed, the movements could be analyzed and warnings sounded if a collision is predicted.

FIG. 1



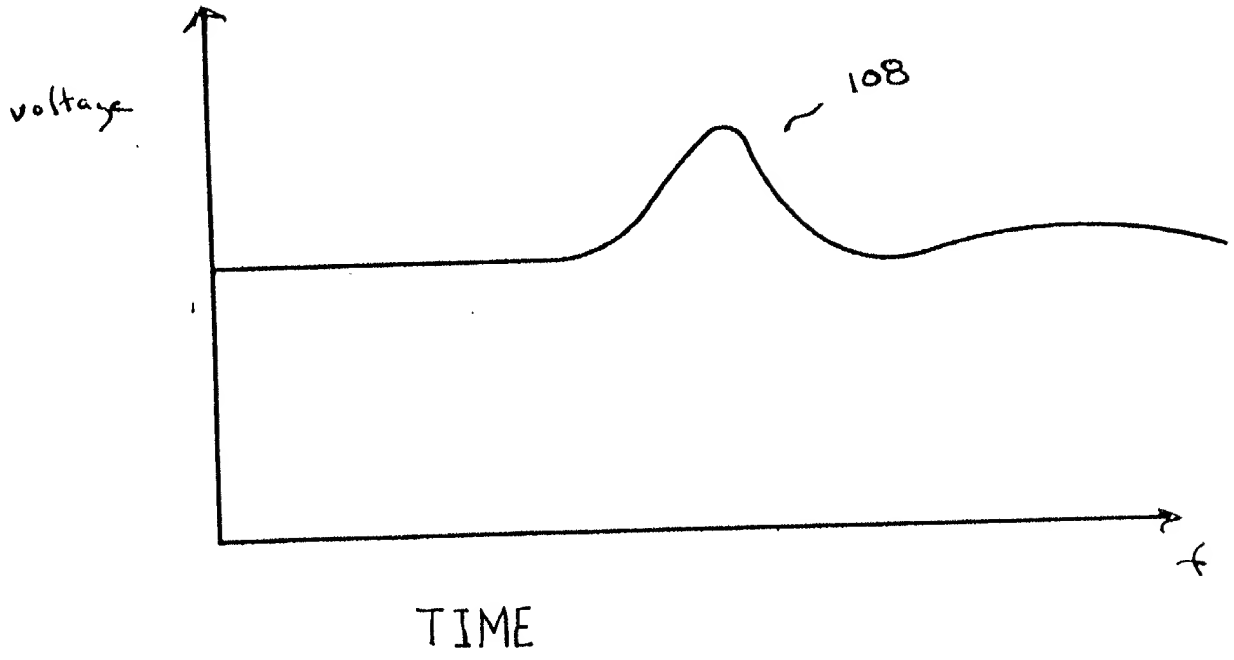


FIG 2

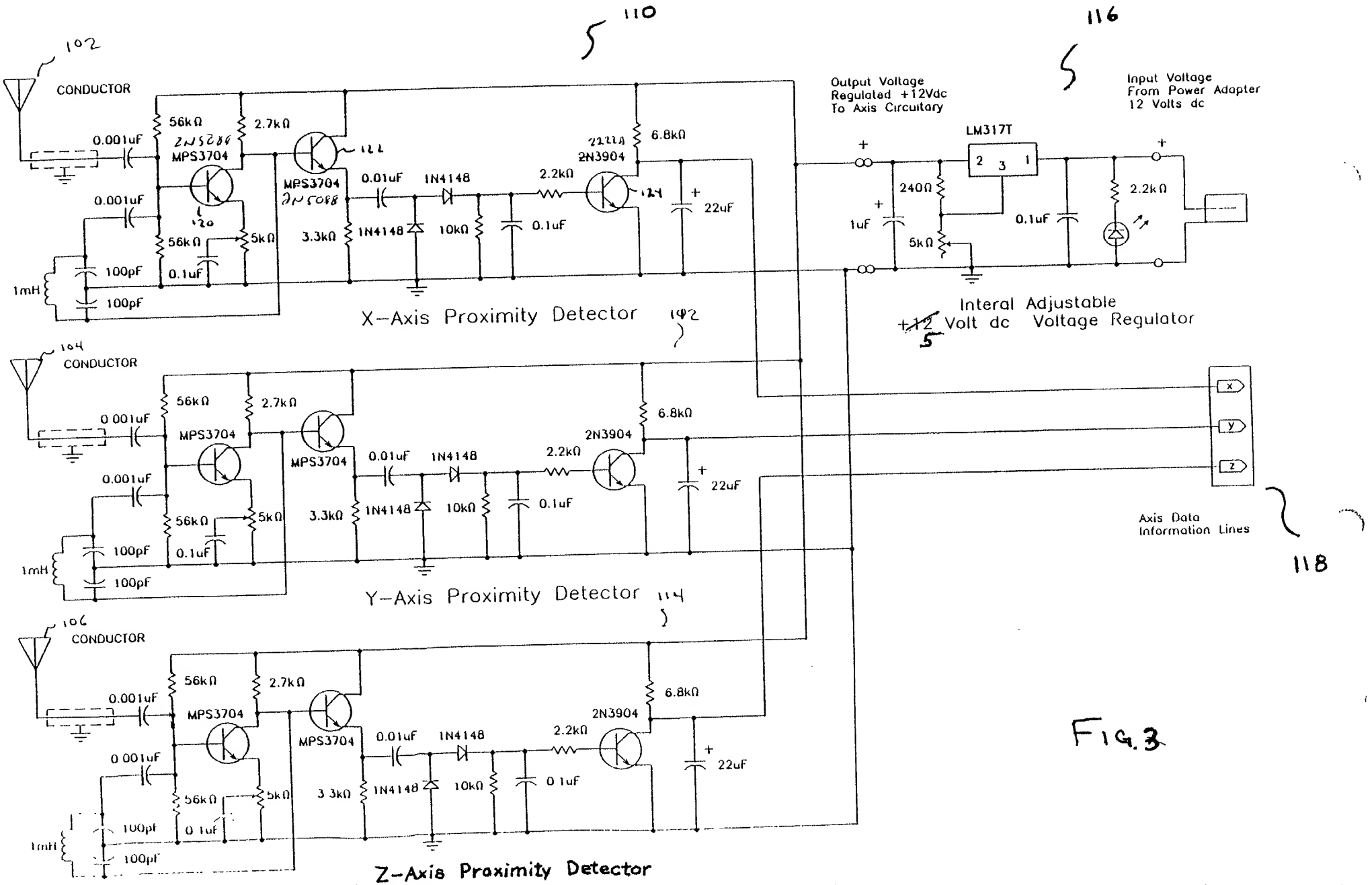

110
116
102
CONDUCTOR
0.001uF
56kΩ
2.7kΩ
2N5088
MPS3704
122
120
0.01uF
1N4148
2.2kΩ
2222A
2N3904
124
6.8kΩ
22uF
0.1uF
10kΩ
3.3kΩ
5kΩ
100pF
1mH
Output Voltage
Regulated +12Vdc
To Axis Circuitary
Input Voltage
From Power Adapter
12 Volts dc
LM317T
240Ω
1uF
2.2kΩ
Interal Adjustable
+12 Volt dc Voltage Regulator
X-Axis Proximity Detector 112
104
106
Y-Axis Proximity Detector 114
Z-Axis Proximity Detector
x
y
z
Axis Data
Information Lines
118

FIG. 3

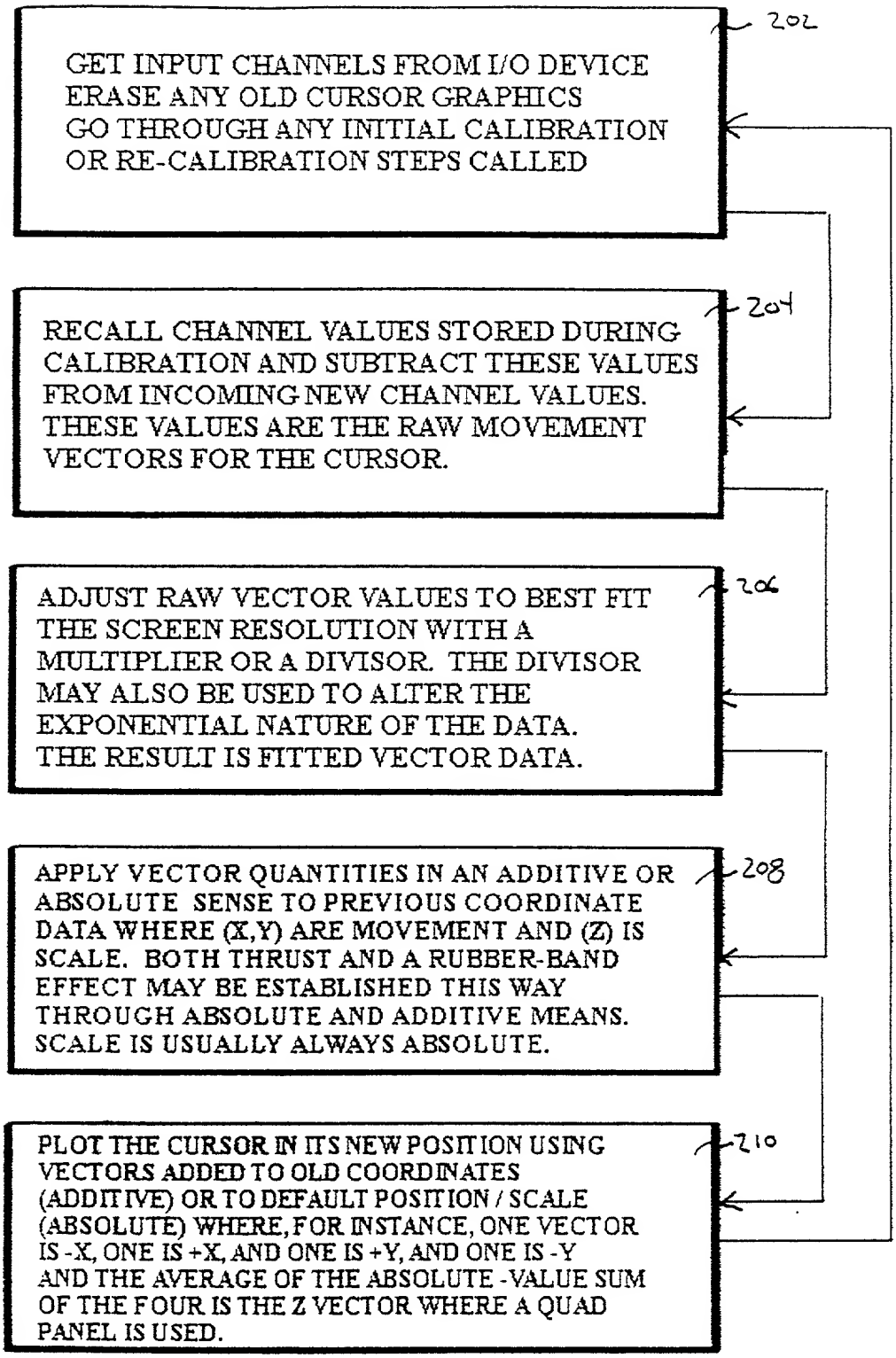

200
202
GET INPUT CHANNELS FROM I/O DEVICE
ERASE ANY OLD CURSOR GRAPHICS
GO THROUGH ANY INITIAL CALIBRATION
OR RE-CALIBRATION STEPS CALLED
204
RECALL CHANNEL VALUES STORED DURING
CALIBRATION AND SUBTRACT THESE VALUES
FROM INCOMING NEW CHANNEL VALUES.
THESE VALUES ARE THE RAW MOVEMENT
VECTORS FOR THE CURSOR.
206
ADJUST RAW VECTOR VALUES TO BEST FIT
THE SCREEN RESOLUTION WITH A
MULTIPLIER OR A DIVISOR. THE DIVISOR
MAY ALSO BE USED TO ALTER THE
EXPONENTIAL NATURE OF THE DATA.
THE RESULT IS FITTED VECTOR DATA.
208
APPLY VECTOR QUANTITIES IN AN ADDITIVE OR
ABSOLUTE SENSE TO PREVIOUS COORDINATE
DATA WHERE (X,Y) ARE MOVEMENT AND (Z) IS
SCALE. BOTH THRUST AND A RUBBER-BAND
EFFECT MAY BE ESTABLISHED THIS WAY
THROUGH ABSOLUTE AND ADDITIVE MEANS.
SCALE IS USUALLY ALWAYS ABSOLUTE.
210
PLOT THE CURSOR IN ITS NEW POSITION USING
VECTORS ADDED TO OLD COORDINATES
(ADDITIVE) OR TO DEFAULT POSITION / SCALE
(ABSOLUTE) WHERE, FOR INSTANCE, ONE VECTOR
IS -X, ONE IS +X, AND ONE IS +Y, AND ONE IS -Y
AND THE AVERAGE OF THE ABSOLUTE -VALUE SUM
OF THE FOUR IS THE Z VECTOR WHERE A QUAD
PANEL IS USED.

Fig. 4

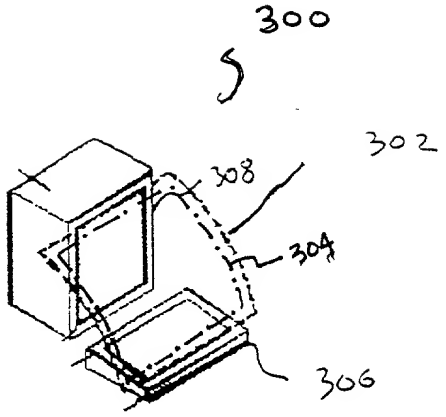


Fig. 5a

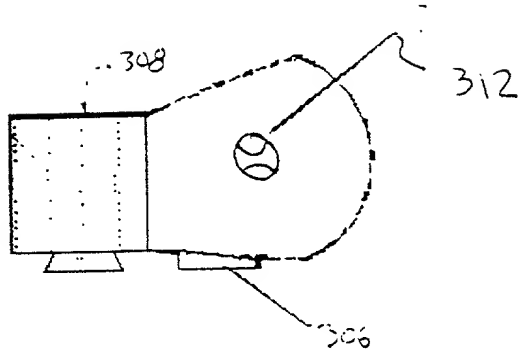


Fig. 5b

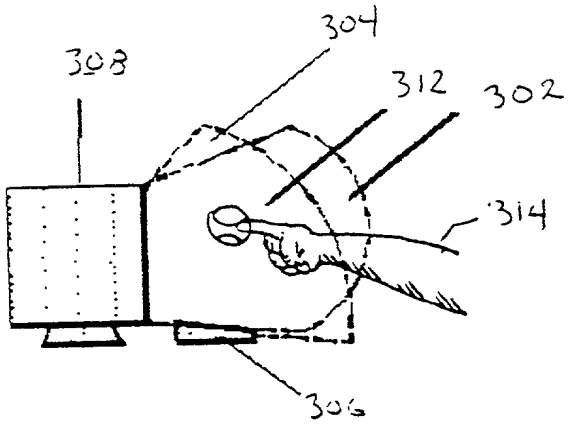


Fig. 5c

Fig 5

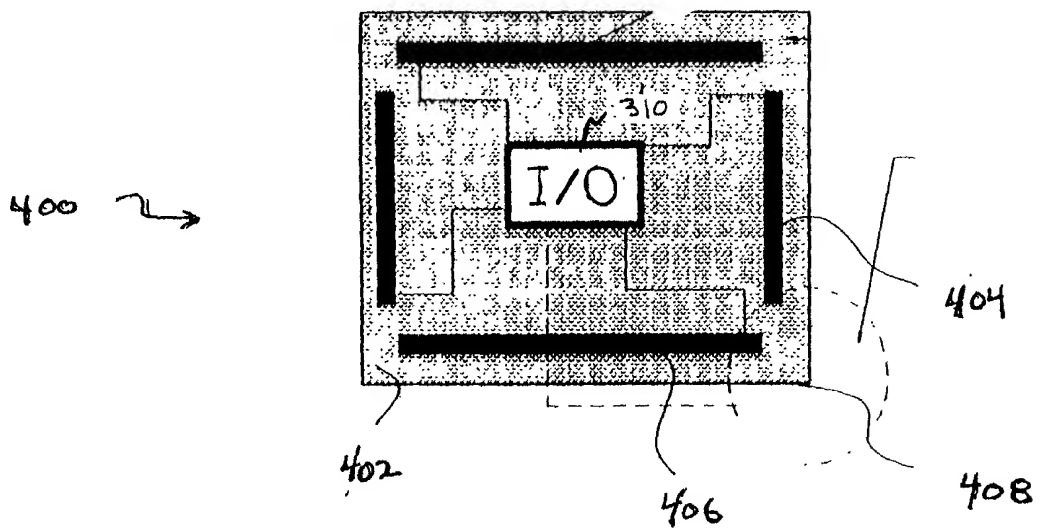


FIG 6

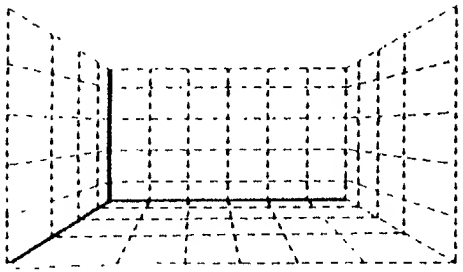


FIG 7a

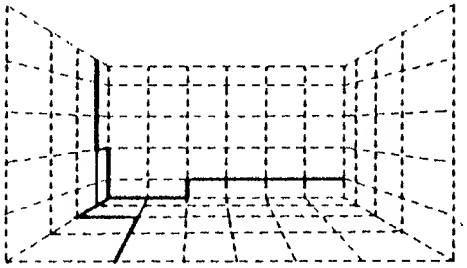


FIG 7b

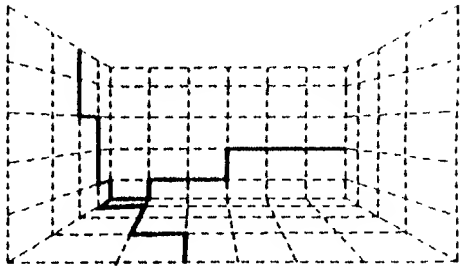


FIG 7c

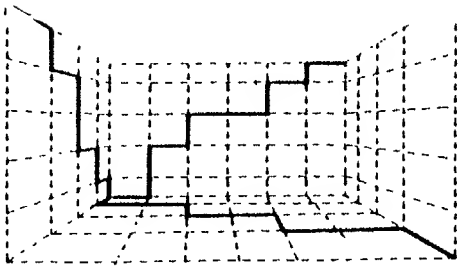


FIG 7d

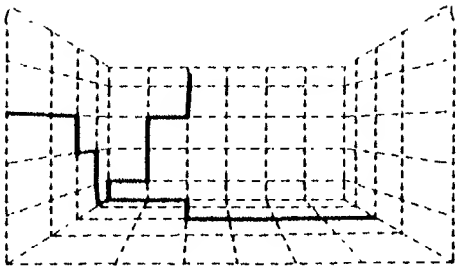


FIG 7e

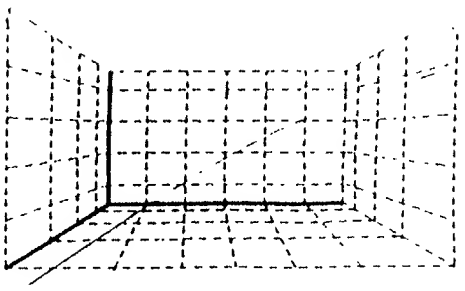


Fig 7f

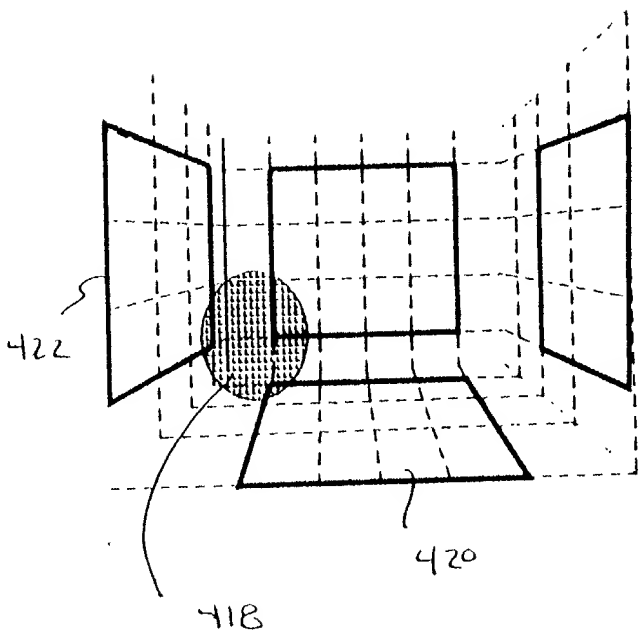


Fig 7g

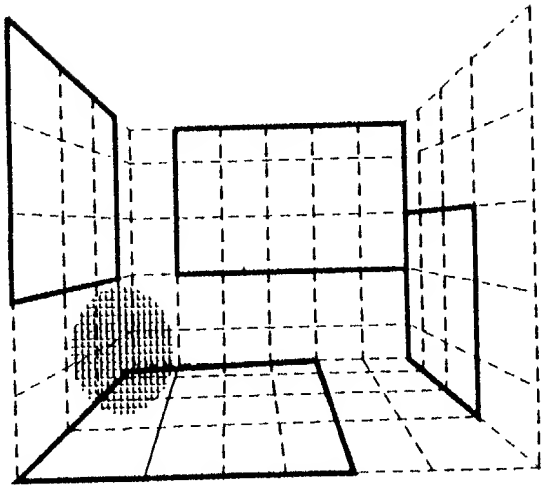
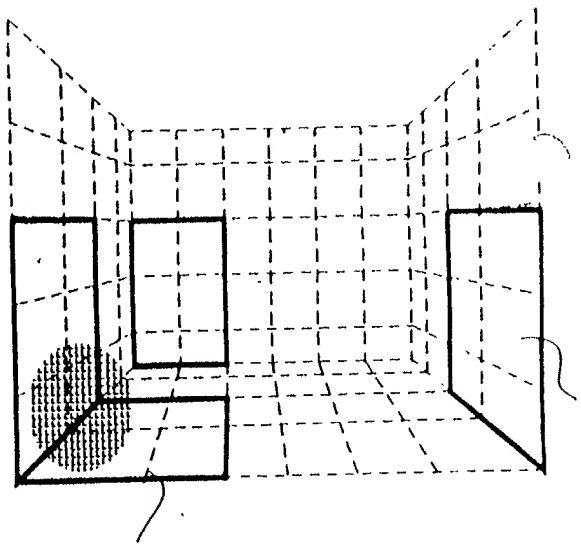


Fig 7h



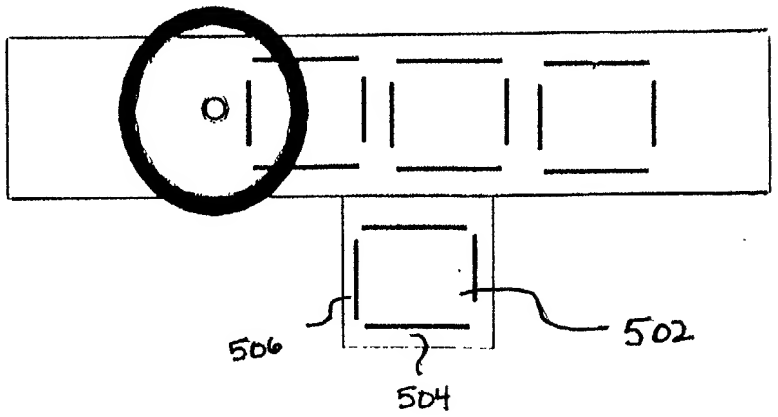


FIG 8

FIG 9

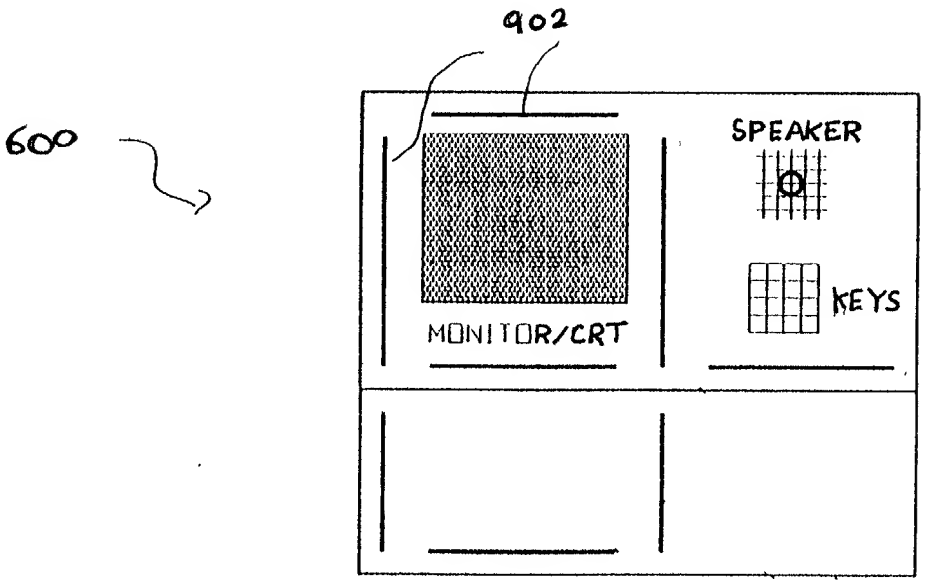
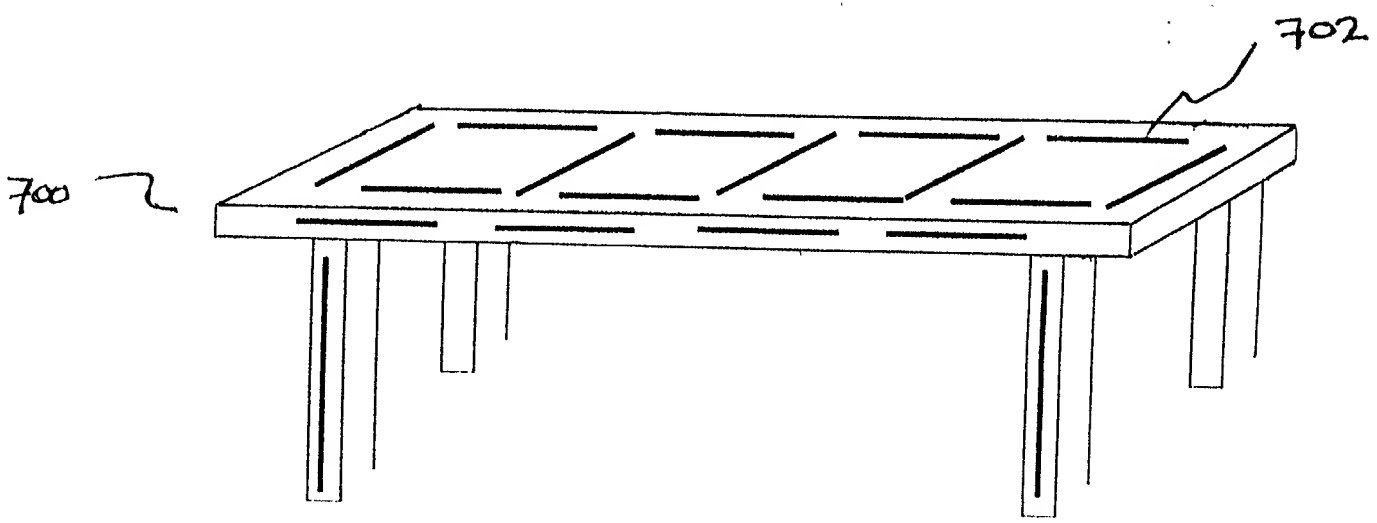


FIG. 10



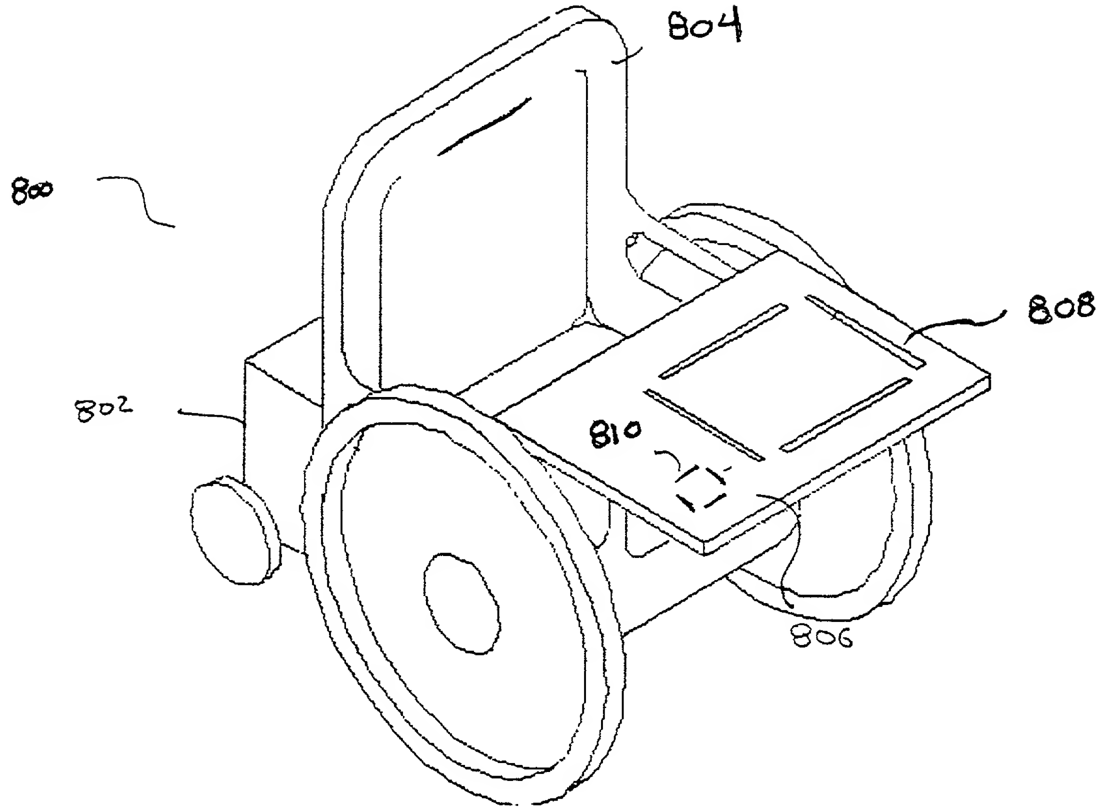
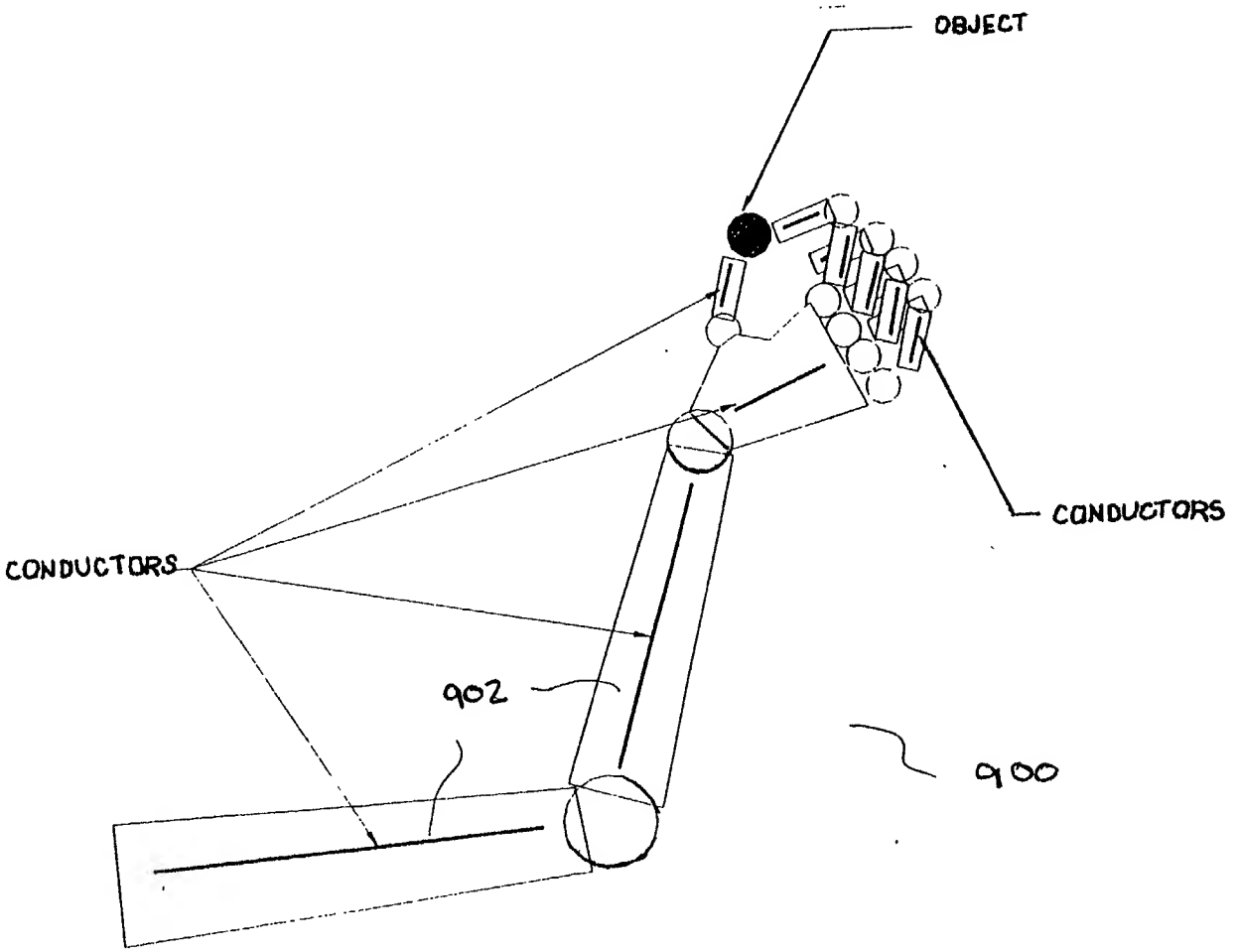


FIG. 11

FIG. 12



35684.0101 PATENT

DECLARATION AND POWER OF ATTORNEY

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention, design or discovery entitled:

COMPUTER INTERFACE DEVICE

the specification of which is attached hereto.

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability of this application as defined by Title 37, Code of Federal Regulations, § 1.56.

I hereby claim no foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate on which priority is claimed.

I hereby claim no benefit under 35 U.S.C. § 120 of any United States application(s) for patent.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in § 1.56 which became available between the filing date of any prior application(s) and the national or PCT international filing date of this application.

I hereby appoint:

JOHN M. CONE, Registration No. 30,538;
WILLIAM FLOYD CLAYBORN, Registration No. 35,845;
GEORGE R. SCHULTZ, Registration No. 35,674;
DAVID W. CARSTENS, Registration No. 34,134; and

all of the firm of Strasburger & Price, L.L.P. my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith, and to file and prosecute any international patent applications filed thereon before any international authorities under the Patent Cooperation Treaty.

Send correspondence to: David W. Carstens
Strasburger & Price, L.L.P.
901 Main Street, Suite 4300
Dallas, Texas 75202

Direct telephone calls to: David W. Carstens
at (214) 651-4478

Atty. Docket No.: 35684.0101

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full name of inventor: Matthew Davis Gard

Inventor's signature: Matthew D Gard

Date: 11/22, 1996

Residence (City, County, State): Dallas, Dallas, Texas

Citizenship: U.S.A.

Post Office Address: 3015 County Sq. Drive #2063
Carrollton, Texas 76006

DECLARATION CLAIMING SMALL ENTITY STATUS PURSUANT TO 37 CFR 1.9(f) and 1.27(c)

INDIVIDUAL INVENTOR

I hereby declare that rights under contract or law have been conveyed to and remain with myself, as an individual, with regard to the invention, entitled:

COMPUTER INTERFACE DEVICE

by inventor: **Gard, Matthew Davis**

described in the application attached hereto.

I hereby declare that I would be classified under 37 CFR 1.9(c) as an independent inventor if I had made the above referenced invention.

No rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. [37 CFR 1.28(b)]

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Name: **Matthew Davis Gard**

Address: 3015 County Sq. Drive #2063
Carrollton, Texas 76006

Matthew Davis Gard

11/22/96
Date

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Application No.:	New Application
Title:	Computer Interface Device
First Named Inventor:	Matthew David Gard
Attorney Docket No.:	35684.0101 (P0002)

REVOCATION/APPOINTMENT OF POWER OF ATTORNEY

Assistant Commissioner of Patents
Washington, DC 20231

I hereby revoke less than all previous powers of attorney or authorization of agents in the above application. Revocation applies to the following person(s):

George R. Schultz, Reg. No. 35,674
John M. Cone, Reg. No. 30,538
David W. Carstens, Reg. No. 34,134

I hereby appoint the Practitioners at **Customer Number 21966** (Bar Code), at the law firm of Strasburger & Price, L.L.P., as the attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the Patent and Trademark Office connected with this application.

Please **change the correspondence address** for the above-identified application to:

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I am an Attorney of Record for this application.

Dated this 6th day of January, 1999.

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